Guest Editorial

Fertilizers, Water Quality, and Human Health

Fertilizer use has increased 10-fold since World War II. Current application rates are staggering and greatly exceed the amounts absorbed by plants. For example, the average amount of nitrogen applied to corn in the Midwest is approximately 160 kg/hectare/year, and in California > 200 kg/hectare/year is added to more than 3 million cultivated hectares [U.S. Department of Agriculture (USDA) 1991, 2003].

The geochemical fate of this excess nitrate is complex, but it is evident that much of it becomes non–point source pollution that degrades both surface waters and valuable groundwater supplies. Large increases in nitrate loads accompany flood pulses in midwestern rivers, and these loads clearly originate in the "Corn Belt," where nitrate application is highest (Goolsby et al. 1993; Meade 1995; Winston and Criss 2003). Much of this load ends up in the Gulf of Mexico, where a hypoxic "dead zone" of up to 20,000 km^2 develops each year, much to the detriment of the aqueous environment (e.g., Goolsby 2000; McIsaac et al. 2001).

Other paths convey nitrate downward into shallow groundwater, an essential resource that provides the domestic water supply for nearly 50% of Americans. Nitrate contamination of well water is now widespread in the United States (Nolan et al. 1998). Numerous case histories document that the change from potable to nonpotable nitrate contents can occur very rapidly (e.g., Snow et al. 1988). Moreover, well contamination is aggravated by low groundwater levels (Davisson and Criss 1993), so one can predict that further rapid degradation of drinking-water supplies will accompany the current drought conditions in the western United States. This problem has been most severe in California, where several municipalities in the Central Valley and coastal valleys such as the Salinas have been forced to abandon entire well fields because nitrate levels have risen sharply above the maximum contaminant level (Davisson and Criss 1996).

These contaminant levels were established to prevent acute exposure that leads to methemoglobinemia, or "blue baby syndrome," in infants, which can be potentially fatal (Knobeloch et al. 2000). Further, chronic exposure to nitrate-contaminated drinking water in Spain, China, and Taiwan has more recently been linked to increased risk of gastric cancer (Knobeloch et al. 2000; Morales-Suarez-Varela et al. 1995; Xu et al. 1992; Yang et al. 1998), which may have profound implications for potential health risks from our widespread non–point source nitrate contamination in the United States.

Widespread nitrate contamination is not necessary. Nitrate contamination is one of many problems that can arise when profits are based on short-term economics, in this case on maximized crop yields. Such faulty cost analysis neglects the long-term consequences of commercial activities and the fact that those consequences need not be confined to the properties where problems originate. We can do better.

Robert E. Criss
Washington University
St. Louis, Missouri
E-mail: criss@wustl.edu

M. Lee Davisson
Lawrence Livermore National Laboratory
Livermore, California

Robert E. Criss

M. Lee Davisson

Robert E. Criss is a professor of earth and planetary sciences at Washington University. His research focuses on stable isotope studies of natural waters and water–rock interactions.

M. Lee Davisson is a staff researcher at Lawrence Livermore National Laboratory, where he conducts numerous studies tracing sources and ages of water and contaminants using analytical chemistry and isotope geochemistry methods.

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